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(71) Applicant: NORTHERN TELECOM LIMITED [CA/CA];
Station A, P.O. Box 6123, Montreal, Quebec M3C 3J5 (CA).

(72) Inventors: TRUDEAU, Joseph, Jean-Paul, Denis; 109 Primrose Avenue, Ottawa, Ontario K1R 6M2 (CA). CRADDOCK, Arthur, Julian, Patterson; 6486 Wadding Drive, Greely, Ontario K4P 1E7 (CA). KHUWAJA, Ramzan, A.; 18 Deerfield Drive, #1603, Nepean, Ontario K2G 4L1 (CA). ARMSTRONG, Steve, Michael; 24 Hillview Road, Nepean, Ontario K2H 5G5 (CA). PARSONS, Eric, Walter; 3 Lakewood Drive, Richmond, Ontario K0A 2Z0 (CA). MACFARLANE, Ian, Alexander, 15 Victor Street, Stittsville, Ontario K2S 1H9 (CA).

(74) Agents: STRATTON, Robert, P. et al.; Gowling, Strathy & Henderson, Suite 4900, Commerce Court West, Toronto, Ontario M5L 1J3 (CA).

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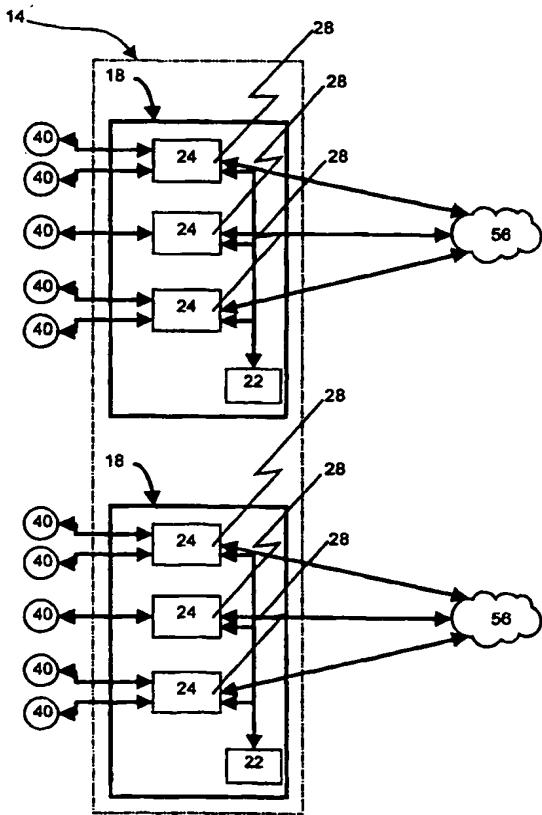
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(54) Title: DISTRIBUTED SERVICE NETWORK

(57) Abstract

A distributed service network provides telecommunications and other services to users via components and services at interconnected network regions. Each region maintains a record of the services and components available in the region and utilization of these services and/or components is obtained by reference to the record. New services and components can be added to the region by updating the record, and services and components can be removed from the region, for preventative maintenance, etc., by appropriately updating the record. Entries in the record can be ordered to determine the order in which like components and/or services are utilized and this order can be set according to the degree of utilization of region servers on which said services and/or components are installed. It is also possible to include services and/or components at other regions, which are accessible via a communications backbone, in the record of services and components in a region.



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DISTRIBUTED SERVICE NETWORK**FIELD OF THE INVENTION**

The present invention relates to a distributed service network. More specifically, the 5 present invention relates to a network which provides communications and other services to fixed, mobile and nomadic users in a manner which is transparent to external service providers and users. The present invention also relates to a reconfigurable distributed service network which provides communications components and user services to fixed, mobile and nomadic users in a manner which is transparent to external service providers and users and which can have services and/or 10 components added and removed, as desired, during operation of the network. The present invention also relates to a data stream conversion system and method which converts a data stream from a first format to a desired format. The present invention also relates to a method of servicing data access requests from users connected to a distributed service network wherein the data access requests are serviced independent of the actual connection point and communications client 15 employed.

BACKGROUND OF THE INVENTION

Recent developments in telecommunications have resulted in networks for a wide variety of services. From conventional voice or data networks to wireless packet and enhanced paging 20 networks, the variety of telecommunications options available to individuals and business is staggering. This variety of options has lead to a revolution in how people live and work and mobile and/or nomadic workers are becoming increasingly common.

While the available telecommunications services have been adopted to various degrees, to a large extent these services, and the networks that support them, remain separate from each other 25 reducing the overall potential of these services. For example, it may not be possible to send email from a personal computer client in an office to a pager client used by a salesman, even though both are connected to respective telecommunications networks.

This lack of integration and/or communication between networks and clients is a recognized problem and a variety of "middleware" products have been proposed and/or produced to transfer 30 data between one network/system and another network/system. For example, Chapter 5 of the publication, "Understanding the Next Phase of Mobile Computing", 1997, by the Yankee Group is entitled, "Evolving Middleware Solutions for Wireless Remote Access" and discusses middleware solutions for communications with mobile users via wireless communications.

While middleware can be configured to provide the desired interconnectivity for many 35 specific situations, to date no general solution exists to interconnect various telecommunications networks. Further, no solution exists to provide a distributed network to supply a variety of desired services at multiple sites in an essentially transparent and convenient manner for users and service

providers. Further, no solution exists to provide a distributed network which allows new services and/or components to be added to or removed from the network, while the network is in operation. Thus, the long sought goal of communication from any client or service to any other client between any two locations is still largely an unachieved goal.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide a novel network, network region and method for providing telecommunication services which obviates or mitigates at least one disadvantage of the prior art.

10 It is an object of the present invention to provide a novel reconfigurable network, network region and method for providing telecommunication services which obviates or mitigates at least one disadvantage of the prior art.

It is a further object of the present invention to provide a novel data stream conversion system and method which obviates or mitigates at least one disadvantage of the prior art.

15 It is a further object of the present invention to provide a novel method of servicing data access requests from users connecting to a network with multiple access points which obviates or mitigates at least one disadvantage of the prior art.

According to a first aspect of the present invention, there is provided a region for use in a distributed telecommunications network, comprising:

20 at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

25 at least one bridge connected to said at least one region server and operable to establish connections with communications clients;

at least one adapter connected to said at least one region server, said adapter operable to connect to an external service and to permit communications between said external service and said at least one region server; and

30 a region manager connected to each of said at least one region servers and operable to determine the type of a communications client connected to said region and to select a region server and a bridge connected thereto to maintain a connection with said communications client, and wherein data received from either of said external service and said communications client which is in a first data format incompatible with the other of said external service and said communications client is converted to a second data format appropriate to aid other of said external service and said 35 communications client by said transducer.

According to another aspect of the present invention, there is provided a distributed service

network comprising at least two regions connected by a communications backbone, each said region comprising:

at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host
5 operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

at least one bridge connected to said at least one region server and operable to establish connections with communications clients;

at least one adapter connected to said at least one region server, said adapter operable to
10 connect to an external service and to permit communications between said external service and said at least one region server; and

a region manager connected to each of said at least one region servers and operable to determine the type of a communications client connected to said region and to select a region server and a bridge connected thereto to maintain a connection with said communications client, and
15 wherein data received from either of said external service and said communications client which is in a first data format incompatible with the other of said external service and said communications client is converted to a second data format appropriate to aid other of said external service and said communications client by said transducer.

The present invention provides a novel distributed service network which allows users to
20 access telecommunications and other external services from any access point in the network. These services are provided transparently to the user and are also provided transparently to the service provider. The network can be customized for each type of client, using parameters known for that client, and can be customized for each user's preferences. Communications through the network are independent of the transport protocol employed, as all protocol, data, API, etc. conversions are
25 automatically performed by a data conversion system and/or adapters in the network. Also, the network and its services are transparent as to where the user connects to the network.

According to a further aspect of the present invention, there is provided a region for use in a reconfigurable distributed telecommunications network, comprising:

at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host
30 operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

at least one bridge or other component connected to said at least one region server and operable to establish connections with communications clients;

35 at least one adapter connected to said at least one region server, said adapter operable to connect to a service and to permit communications between said service and said at least one region server; and

a region manager connected to each of said at least one region servers and maintaining a record indicative of the services and components available on each of said at least one region servers, said region manager operable to determine the type of a communications client connected to said region and to select from said record a region server and a bridge or other component
5 connected thereto to service a connection with said communications client.

According to another aspect of the present invention, there is provided a reconfigurable distributed service network comprising at least two regions connected by a communications backbone, each said region comprising:

at least one region server including at least one transducer operable to convert an input data
10 stream in a first format to an output data stream in a second data format and a communications host operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

at least one bridge connected to said at least one region server and operable to establish connections with communications clients;

15 at least one adapter connected to said at least one region server, said adapter operable to connect to an external service and to permit communications between said external service and said at least one region server; and

a region manager connected to each of said at least one region servers and maintaining a record indicative of the services and components available on each of said at least one region
20 servers, said region manager operable to determine the type of a communications client connected to said region and to select from said record a region server and a bridge or other component connected thereto to service a connection with said communications client.

The present invention provides a novel reconfigurable distributed network and method of operating such a network which allows components and services to be added and/or removed from
25 the network while the network is in operation. Further, the present invention provides a novel reconfigurable distributed network and method of operating such a network which allows balancing of the utilization of components and/or licensed capabilities, both within a network region, and between network regions. Components and services can be added as new components and services become available and/or components and services can be removed for preventative maintenance or
30 reconfiguration, etc. without requiring the network or network region to be taken off line.

According to yet another aspect of the present invention, there is provided a method of processing data access requests of users connected to a reconfigurable distributed service network comprising a plurality of interconnected network regions each comprising at least one region server, said users employing at least one of a plurality of types of communications clients and said
35 network connected to a plurality of services, comprising the steps of:

(i) maintaining for network each region a record indicating the components available for use in said network region;

(ii) determining the type of communications client employed by the user and connecting said communications client to an available component, selected from said record, appropriate to said client;

5 (iii) receiving a data access request from said user for a service selected by said user from said plurality of services; and

(iv) connecting said communications client to an available component, selected from said record, to connect said communications client to said selected service.

According to a further aspect of the present invention, there is provided a data stream conversion system comprising:

10 at least two transducers, each operable to receive an input stream of data in a first format and to create an output stream of said data in a format other than said first format; and

a transducer matrix switch operable to select at least one of said transducers and to provide said first input stream of data thereto and to receive said output stream of data therefrom, said selection being based upon an input signal to said transducer matrix switch indicating said first 15 format and a desired different data format.

According to a still further aspect of the present invention, there is provided a method of converting a data stream transferred between a communication client connecting a user to a distributed service network and a service connected to said network, comprising the steps of:

(i) determining the type of said communications client and the required data characteristics 20 of said client;

(ii) determining the required data characteristics of said service;

(iii) selecting at least one conversion means operable to convert a data stream between said required data characteristics of said client and said required data characteristics of said service;

25 (iv) applying said at least one conversion means to a data stream transferred through said network.

According to another aspect of the present invention, there is provided a method of servicing data access requests for a user accessing a network via a communications client connected to any one of two or more network regions, comprising the steps of:

(i) determining at said network region the type of communications client and transferring 30 said connection to a bridge at said network region which is appropriate for said determined type of client;

(ii) verifying the identity of said user;

(iii) determining any predefined preferences of said identified user and the services which said identified user is able to access by accessing a user profile stored for said user by said network; 35 and

(iv) allowing said user to access any of said determined services, said network region converting data streams to and from said client between a format appropriate to said determined

type of client and a format employed by said accessed service.

According to a further aspect of the present invention, there is provided a method of processing data access requests of users connected to a distributed service network, said users employing at least one of a plurality of types of communications clients and said network connected to a plurality of services, comprising the steps of:

(i) determining the type of communications client employed by the user and retrieving parameters defining required characteristics of said communications client from a storage location in said network;

10 (ii) receiving a data access request from said user for a service selected by said user from said plurality of services;

(iii) determining the required characteristics of data to and from said selected service; and

15 (iv) automatically converting data transferred between said service and said communications client in accordance with said required characteristics of said communications client and said determined characteristics of said user-selected service.

20 The present invention provides a data stream conversion system and method which allows communications clients to connect to a network and access any service therefrom, such that the data streams from the service to the communications client are converted to a desired format for the client without requiring specific input from the user of the client. The data conversion system and method receives information relating to the type of communications client, and any user defined preferences for data streams sent thereto, and information relating to the service being accessed through the network. The data conversion system and method then employs one or more transducers to convert the data stream accordingly. The data conversion system and method also employs one or more transducers to convert a data stream received from the communications client from the received format to a format required for the service.

25 According to a still further aspect of the present invention, there is provided a method of processing data access requests from users connected to a distributed service network including multiple connection points, comprising the steps of:

(i) establishing a connection to a user at a connection point to said network;

30 (ii) locating information defined for said user and stored at a defined location within said network;

(iii) transferring a copy of at least a portion of said information from said defined location to said connection point through said network;

35 (iv) processing data access requests from said user in accordance with said copied information and transferring a copy of additional information required to fulfill said requests from said defined location to said connection point;

(v) transmitting, over said network between said defined location and said connection point, updates representing changes effected at each of said stored information defined for said user and

said copy of said information to each of the other of said stored information defined for said user and said copy of said information to maintain correspondence therebetween.

The present invention provides a novel method of servicing data access requests from users accessing a network with multiple connection points, the services being provided independent of the actual connection point and/or the communication client employed by the user to connect to the network. These method is transparent to the user and to the provider of the accessed service and can be customized for each type of client, using parameters known for that client, and can be customized for each user's preferences for each client. Information relating to the user is copied to and maintained at the connection point to reduce latency and bandwidth requirements through the network.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

15 Figure 1 shows a schematic representation of a distributed service network in accordance with the present invention;

Figure 2 shows a schematic representation of a region in the distributed service network of Figure 1; and

20 Figure 3 shows a schematic representation of the replication of a personal agent from a home region in a distributed service network to a persistent cache in a remote region in that network.

DETAILED DESCRIPTION OF THE INVENTION

A distributed service network in accordance with an embodiment of the present invention is indicated generally at 14 in Figure 1. The types of data carried by network 14 is not particularly limited and can include analog and/or digital voice, computer network communications, email, messages for paging systems, etc. and, as will be apparent from the discussion below, network 14 can simultaneously carry multiple types of data, as desired.

As shown in Figures 1 and 2, network 14 comprises one or more regions 18, each of which 30 comprises a region manager 22 and one or more region servers 24. Each region manager 22 is connected to each region server 24 in its region 18 and each region server 24 is connected to other region servers 24, both those in its region 18 and those in other regions 18, by a communications backbone 28, which can be any suitable communications link, such as T3 lines, high bandwidth fibre optic links, satellite links, etc. or any combination of suitable links.

35 As shown in Figure 2, each region server 24 includes a suitable communications host 32 for communications backbone 28 and a plurality of bridges 36 to which clients 40 of network 14 can be

connected by dedicated telecommunications lines, dial-up access, wireless services, a public packet network such as the internet, or any other suitable means. For clarity, Figure 1 shows three region-servers 24 in each region 18, but it is contemplated that the number of region servers 24 will vary according to contemplated load for the region and/or the services provided at the region. It is 5 contemplated that at least one region 18 will be created for each geographic area where it is desired to provide a local "point of presence" where a client 40 can connect to network 14. However, network 14 is very flexible and it is also contemplated that two or more regions 18 can be located in a single geographic area with a relatively high number of clients 40, etc., if desired, and in such a circumstance, regions 18 and their respective region servers 24 can be interconnected via backbone 10 28 or any other suitable means and region managers 22 can perform load and/or service balancing between regions 18.

As is also shown in Figure 2, region servers 24 include a data stream conversion system comprising set 44 of transducers 46 and a transducer matrix switch 48 to convert data streams between various formats, protocols and standards as required. Region servers 24 also include a set 15 52 of adapters and service agents, which can communicate with other external services and/or networks 56, such as the internet, to communicate with servers running POP3, SMTP, etc., to perform email tasks, faxing, web browsing, etc. As used herein, the terms "format" or "data format" are intended to comprise any representation of data. For example, digitized speech can comprise one format of data, a color image in a GIF file format another, a black and white image in 20 a black & white GIF file format another, a Group IV facsimile transmission another, a html document another, etc. Further, as used herein the term "data stream" is intended to comprise any collection, logical arrangement or grouping of data, including one or more data files, data packets, streams of data such as digital voice, multimedia, or interactive processes, etc.

Each adapter in set 52 provides a layer of transparency between the protocols and/or API's 25 used by the external service or services to which it connects. Specifically, the adapter operates to convert between service specific protocols or APIs and a generic protocol understood by the region server 24. For example, region server 24 communicates with an adapter 52 for email via a generic "get" and "store" protocol and that adapter 52 can convert between this generic protocol and an IMAP4 email protocol. Thus, the region server 24 and services local to that region server need 30 only employ the simple "get" and "store" protocol and not the complexity of the IMAP4 protocol. This also allows new services and/or amended services to be added to region servers 24, as desired, by merely adding additional protocol conversion adapters.

Clients 40 can comprise a wide variety of telecommunications and/or computing devices including, without limitation, personal computers, cellular or PCS handsets, pagers, wireless- 35 capable personal digital assistants (PDAs) and any other device or system which requires voice or data telecommunications services.

Region manager 22 includes a database engine 38, which maintains a variety of information

regarding the users of network 14 and which maintains a registry of information relating to clients 40 which can connect to network 14. This client registry includes information on how to establish and maintain a connection to each client 40, as well as the capabilities and limitations of each client 40. Region manager 22 monitors each region server 24 to perform load balancing between region servers 24, and to manage the establishment of connections, as described below in more detail.

When a client 40 wishes to connect to network 14, either by a dial up line, wireless connection or other data link, a connection, referred to herein as a preliminary connection, is established between the client and one of bridges 36. The region server 24 which is connected to the bridge 36 to which the preliminary connection has been made notifies the region manager 22 which determines the type of client 40. In some circumstances, such as wherein the preliminary connection is established with a GSM cellular telephone employing the SMS protocol, the bridge 36 with which the preliminary connection is established will implicitly identify to the region manager 22 the type of client 40. In other cases, such as the case of a dial up line, region manager 22 and the bridge 36 with which the preliminary connection is established must determine the type of client 40 employed with the connection, such as a digital voice telephone, analog voice telephone, WEB browser, etc. This determination can be effected by analyzing initialization procedures, by querying the client 40, or by any other suitable method as will occur to those of skill in the art.

Once the type of client 40 is identified, region manager 22 checks the client registry in database engine 38 for the characteristics of client 40 and ensures that the preliminary connection is transferred to an appropriate bridge 36, either at the region server 24 to which the preliminary connection was originally made, or to another region server 24, as appropriate. The selection of which region server 24 is to handle the connection can be based upon a number of criteria, including the present workload of each of the region servers 24, the type of client 40, etc. For example, one or more region servers may be configured with specific hardware or otherwise optimized to handle connections to http browser clients 40 and another for voice mail.

If a user changes the type of client 40 being employed while connected to a region server 24, for example changing from a POP3 email client to a web browser client, or if a region server 24 has an excessive load, region manager 22 can transfer control of the connection, if appropriate, to a different region server 24 in region 18 transparently to the user.

Next the identity of the user of client 40 is verified. This verification can comprise: an explicit step, such as the user inputting a user ID and password; or an implicit step, such as the connection being to a known address, such as an IP address or DN (directory number); etc. and can be performed by the region manager 22, or one or more region servers 24 within region 18 which have capacity allocated for this task. In Figures 1 and 2, the former alternative is illustrated and verification information is compared to information in database engine 38 to verify the identity of the user. Once the identity of the user has been verified, the preliminary connection becomes a

complete connection and data access requests from the user are serviced.

In one embodiment of the present invention, once the identity of a user is verified and a complete connection is established, a personal agent for the user is accessed from database engine 38, onto a server 24. The personal agent maintains a record, referred to herein as a user profile, of the services to which the user subscribes, user preferences for various possible client devices employed by that user and any other preferences of the user as well as billing information for the user. In addition to the user profile and preferences, the personal agent also provides access to all relevant services data for user data access requests, including Email services for the user, passwords and user identifications for other services, etc.

10 While the use of a personal agent is presently preferred, network 14 is not limited to the use of a personal agent, and user profiles and related information can be stored in network 14 in any suitable manner as will occur to those of skill in the art.

If the user has connected to a region 18 which is not the "home" region 18 (i.e. -the region 18 at which the user's data normally resides) of the user, the verification is performed by either: consulting a registry of users maintained in database engine 38 to identify the home region 18 of the user; by sending a query to a centralized user registry server (not shown) which is connected to network 14 via communications backbone 28, or by sending a query from the connected (local) region manager 22 to the region managers 22 of neighboring regions 18 via backbone 28 to locate the database engine 38 with required information to verify the user. In this last case, if none of the neighboring regions 18 are the home region 18 of the user and thus do not have the necessary information for the user on their database engine 38, the query is relayed to additional regions 18 until either the home region 18 is identified. If at any point it is determined that the user is not an authorized user for network 14, the preliminary connection between client 40 and bridge 36 is terminated. There are a variety of suitable techniques that will be apparent to those of skill in the art for determining when a user verification query has been successful, or unsuccessful, and this will not be further discussed herein.

Once the home region 18 has been identified for the user and the user's identity has been confirmed and a complete connection established, the personal agent at the home region 18 can be accessed, via communication backbone 28, by the remote region 18 or the personal agent can be replicated to the local region 18 from the home region 18, via backbone 28. The determination of whether to access the personal agent via backbone 18 or whether to replicate the personal agent at the remote region 18 is based upon a suitable preselected quality of service (QoS) metric and can include a consideration of: the communications latency between the remote region 18 and the home region 18 over communications backbone 28; the length of the time the user is expected to require access to the data at the local region 18; the amount of data the user requires access to; and other relevant factors as will occur to those of skill in the art.

If the personal agent for a user is replicated to remote region 18, the entire personal agent is

not necessarily replicated and, preferably, only information which is immediately required, or which is likely to be required imminently, is replicated to reduce the transfer and/or storage of unnecessary data. To further reduce the storage of unnecessary data, the replication of the personal agent in a local region 18 is stored in a persistent cache, as will be described in more detail below.

5 Once a full connection is established with a region server 24, the user has complete access to all services through network 14 which the user is authorized to access, as determined from the user's personal agent or other user profile information, essentially independent of the client 40 he has employed to connect to the network and all authorized data access requests are served by network 14 to client 40. This client independence is accomplished via the client registry and set 44
10 of transducers 46 and transducer matrix switch 48.

Specifically, as mentioned above, region manager 22 and bridge 36 determine what type of client 40 is communicating with bridge 36. This information is used to identify the entry for that client in the client registry and the characteristics of that client, including its requirements, capabilities and limitations are provided to transducer matrix switch 48, as are the characteristics of
15 the type of service being accessed which is determined from the adapter 52 making the connection to the service. The user profile is also accessed to determine any user specified preferences for that type of client.

Transducer matrix switch 48 arranges, configures and/or connects one or more transducers 46 in set 44, as necessary, to convert between the data formats (types and/or protocols) employed
20 by client 40 and the data formats employed by the service being accessed. If no single transducer 46 exists in set 44 which can effect the necessary conversion, then transducer matrix switch 48 will chain two or more transducers 46 together, with the output of one transducer being the input to the next, to accomplish the necessary conversion. In one embodiment, transducer matrix switch 48 receives an input from bridge 36 as to the format employed by client 40 and receives an input from
25 set of adapters 52 as to the data format employed by the external service and these two inputs are used as indices to a look up table, or ordered set, in matrix switch 48 of all possible conversions. The indicated entry in this table defines the required transducer 46, or combination of transducers 46, to effect the desired conversion. As new transducers 46 are added to set 44, the conversion look up table is updated accordingly.

30 Further, in some circumstances two or more transducers 46, or chains of transducers 46, can be employed in parallel. For example, a Group IV facsimile message can be received by one of set 52 of adapters for access by a PCS telephone client 40. In such a case, a first transducer 46 can be employed to perform an optical character recognition (OCR) conversion from the facsimile format to ASCII text format and then a pair of transducers 46 can simultaneously examine the resulting
35 text, one to locate to locate the facsimile sender's name and/or telephone number, and the other to locate the subject matter of the facsimile from a "subject" line. The located "from" and "subject" information is then sent to the user's PCS telephone, in accordance with the client registry

information for PCS clients and the users preferences for that client, from the user's profile.

As will be apparent to those of skill in the art, in order to efficiently utilize transducers 46, they can be implemented within a multi-threaded architecture. In this case, every transducer 46 is always available as the architecture will essentially maintain a pool of threads for use.

- 5 As an example of the use of a data conversion system in accordance with the present invention, if a user has connected to network 14 via an analog voice telephone client 40 and wishes to access email services, a touch tone response transducer 46 and a text to speech transducer 46 are selected and configured by transducer matrix switch 48 and portions of the email messages will be read to the user. Depending upon the preferences and/or set-up defined by the user for the client
- 10 40, as stored in the user's personal agent or other user profile, the user can be provided with the email in a variety of manners. For example, the user can be provided with a prompt, via the text to speech transducer 46, informing the user of the number of new Email messages which have been received and/or the messages or their subject lines can be read to the user via the text to speech transducer 46. A touch tone response transducer 46 can allow the user to select messages of
- 15 interest to be read or messages to be deleted, etc. by pressing keys on a touch tone phone. A speech recognition transducer 46 can also be employed, either in instead of or in addition to, the touch tone response transducer 46. In such a case, the user can dictate responses to Email, etc. Alternatively, the user can have set their preferences in their personal agent or user profile such that they are only informed of the number of new email messages, and their time of receipt.
- 20 As will be apparent, the user's personal agent or user profile can include different preferences for each service when delivered on each different client 40. For example, when the user connects to network 14 via a dial up line with a personal computer running an email program as client 40, the user's email will be fully available to them from the email program in a conventional manner, rather than being read to them via text to speech transducer 46. If that
- 25 personal computer has connected to network 14 via a cellular modem, with a limited and/or costly bandwidth, the email can be presented as subject lines only, except for messages flagged as urgent. Many other possible configurations and/or options will occur to those of skill in the art.

As mentioned above, transducers 46 can be chained, as necessary, by transducer matrix switch 48 to provide required conversions. For example, if a user wishes to access a web page from

30 an analog voice telephone, transducer matrix switch 48 can employ an HTML to ASCII transducer to receive the HTML definition of the web page and to convert it to ASCII text which would then be passed to a text to speech transducer 46 to convert that ASCII text to speech that the user can receive on their telephone. Similarly, speech recognition or touch tone response transducers can be employed to receive input from the user as to hot links to be followed or other inputs desired.

35 Set 44 of transducers 46 and transducer matrix switch 48 provide transparent conversion of services within network 14. It is contemplated that, at least to some extent, all services will be transparent or accessible, in accordance with user defined preferences stored in the users' personal

agents and that such transparency will not require any steps on the part of the service provider. For example, a user can define that only a count of new Email messages received be sent to their pager, or that a count of all new messages received and the subject lines of messages marked urgent be downloaded, etc. and yet the sender of the email message need not concern themselves with such details.

It is contemplated that, in some circumstances, different region servers 24 in a region 18 can have different transducers 46 in their set 44. For example, a region server 24 can have one or more transducers 46 for text to speech conversions which require special purpose hardware in region server 24. In such a case, only one region server 24 in a region 18 may be equipped with such special purpose hardware and a connection to a client 40 which requires a text to speech transducer 46 can be transferred, as necessary, by matrix transducer switch 48 in the region server 24 handling the connection to a region server 24 in another region 18 which has the necessary transducer 46. The determination of which other region server 24 has the necessary transducer 46 can be determined, for example, by consulting a table of this information which is maintained in each region manager 22 or by any other suitable means, as will be apparent to those of skill in the art.

In addition to performing service to client conversions, network 14 can also perform transport protocol conversions as well. An adapter in set 52 can receive data in one transport protocol and can forward it to another adapter in set 52 wherein it is re-transmitted via another transport protocol. For example, data can be received via TCP/IP by a first adapter in set 52 and transmitted from a second adapter in ATM or Frame Relay protocol. It is contemplated that set 52 can also include encryption and/or decryption engines as well. It is also contemplated that, in some circumstances, transducers 46 can be employed to perform protocol conversions and/or encryption and decryption if desired. It is also contemplated that set of adapters 52 and/or set 44 of transducers can provide API's for legacy logging and billing subsystems to facilitate record keeping for Internet service providers (ISP's), telephone companies, cellular telephone companies, etc.

As mentioned above, there is preferably a personal agent defined for each user which accomplishes several tasks. For example, the personal agent provides access to the information necessary to identify the user to network 14, by a user ID and password, a known IP address, a pager number, a cellular EIN, etc. Additionally, the personal agent can provide access to information such as account and/or password information for third party services to which the user subscribes. For example, for the user can subscribe to a stock quotation and information service which requires the user to identify themselves to the service before being allowed to access the desired the information. While such uses of the personal agent provide convenience to the user, in not having to remember account numbers, passwords, etc., the personal agent can in fact do much more.

Specifically, the user can instruct their personal agent to perform a variety of tasks, ranging from the simple to the quite sophisticated. For example, the user can have defined that their

personal agent contact the above-mentioned stock quotation service once every hour to determine the current price of one or more stocks and, if the prices reach a certain price, to contact the user in a defined manner, such as by sending them an email, or paging them, providing them with a synthesized voice message in a voice mailbox or by contacting them on their analog cellular

5 telephone. As will be apparent, set 44 of transducers 46 and transducer matrix switch 48 will be employed, as necessary, in contacting the user via an appropriate client 40, such as by employing a text to speech transducer 46 to provide them with a voice notification on their cellular telephone. It will be apparent to those of skill in the art that a personal agent is not service specific and a personal agent for a user is available for any service available to the user. Thus, it is contemplated
10 that each user can have a single personal agent for all tasks. It is also contemplated that a computer-based graphical user interface will be available to users to allow them to select and define tasks for their personal agents which tasks are then transferred to the personal agent via network 14. The construction and operation of such a PC-based interface, or other suitable means for defining tasks and options for a personal agent, will be apparent to those of skill in the art.

15 As also mentioned above, the present invention includes a persistent caching system for personal agents. As shown in Figure 3, the home region 18a for a user includes a master personal agent 80 stored in database engine 38a. When a user connects to network 14 through a remote region 18b, and if a predefined QoS metric is not met by accessing the master personal agent 80 via communications backbone 28, master personal agent 80 is replicated, as replicated personal agent 20 80r, via communications backbone 28 to remote region 18b where it is placed in the persistent cache of database engine 38b. As mentioned above, in the initial replication only a minimum portion of the personal agent is replicated. For example, only the information required to identify the user, the services to which the user is subscribed and the user's billing information is transferred.

25 Once a complete connection is established, depending upon the user's activities, additional information can be transferred to replicated personal agent 80r and/or updates from replicated agent 80r are transmitted to master personal agent 80. For consistency, master personal agent 80 is always updated by a replicated personal agent 80r to reflect all changes and some changes which occur at master personal agent 80 are automatically updated to replicated personal agent 80r. This 30 minimal replication reduces bandwidth and messaging requirements by keeping as much activity as possible within the local region 18b, reducing communications through communications backbone 28.

For example, a user can connect to remote region 18b and the region manager in region 18b locates the master personal agent 80 for the user in region 18a, the user's home region. A 35 replicated personal agent 80r for the user is transferred to region 18b from region 18a and is employed to verify the identity of the user. At this point, depending upon the activities of the user, a variety of transfers can occur between the persistent cache in database engine 38b of region 18b

and master personal agent 80. If the user merely places a voice mail message in another user's voice mail box, a billing entry can be added to replicated personal agent 80r and an update transferred to master personal agent 80 to reflect this billing entry.

In a more interesting example, the user can conduct an email session, reading, replying,

- 5 deleting and creating various messages as desired. In such a case, the user's inbox and address list will be replicated at personal agent 80r and appropriate updates transmitted to master personal agent 80 to flag messages as having been read and/or to remove messages which have been deleted and to update the address list to reflect any changes made by the user. When the user creates new email messages, those messages are sent in a conventional manner and placed in the user's outbox
- 10 10 in the persistent cache and updates are sent to master personal agent 80 to be placed in the users' outbox therein. Any email messages received at master personal agent 80 can be automatically replicated to replicated personal agent 80r, if desired. As will be apparent to those of skill in the art, this replication technique can also be employed for GSM voice services to accommodate the Home Location Registry and the Visitor Location Registry employed therein.

- 15 Further, in some circumstances data will be transferred from a personal agent (either master personal agent 80 or replicated personal agent 80r) to a client 40 and subsequently changed in that client 40. When that client 40 next connects to network 14, master personal agent 80 can be updated to reflect those changes, either directly or via an update from replicated personal agent 80r. For example, a list of telephone numbers can be downloaded into a client 40 such as a personal
- 20 20 digital assistant (PDA) or cellular telephone and the user can subsequently add, delete or amend entries in that list. When that client 40 is again connected to network 14, the copy of that list in master personal agent 80 is updated from client 40 to reflect the additions, deletion and amendments made by the user.

As will be apparent to those of skill in the art, the operation of the persistent cache is

- 25 transparent to the user and is employed to enhance performance of network 14 by reducing latency time, and in conjunction with the replication strategies, to reduce bandwidth consumption too, where possible. The persistent cache can employ any suitable caching strategy, as will occur to those of skill in the art, but it is contemplated that a FIFO (first in first out) strategy will be employed wherein replicated personal agents 80r in the persistent cache are ranked according to
- 30 30 their age in the cache and, when a portion of the cache must be flushed, the oldest entries are removed. This strategy can be enhanced by also tracking for each entry in the persistent cache whether its corresponding master personal agent 80 has been accessed at the home region 18a, or replicated to another remote region, after the last access time of the replicated personal agent 80r in the persistent cache. Replicated personal agents 80r at a region 18b whose corresponding master
- 35 35 personal agents 80 have been accessed or replicated since the last access to the replicated personal agent 80r, are flushed from the cache in region 18b.

As will be apparent to those of skill in the art, once a complete connection is established

between a client 40 and a region 18, security is maintained by network 14. All connections through communications backbone 28 are secure and/or encrypted to ensure that the identity of the user is authenticated and that the data communications within network 14 are private. Further, communications via set 52 of adapters and service agents with other services can be encrypted and 5 decrypted, as required.

Regions 18 have been constructed of components which are implemented in software, where appropriate, or which have software interfaces which allow for easy upgrading, enhancement and to provide "hot-plugability", i.e.- the ability to add or remove services and/or hardware while network 14 is in operation. Specifically, bridges 36 comprise the necessary hardware to establish 10 connections to client 40 and comprise a software-implemented control which manages the communication with region servers 24. Similarly, database engine 38 includes a suitable database engine and a software-implemented control which manages the persistent cache and other functions of the database engine 38. Set 44 of transducers 46, and transducer matrix switch 48 also comprise 15 software-implemented components which either control hardware and/or firmware to perform their necessary functions, or which perform these functions themselves. Similarly, set 52 of adapters and service agents include the necessary hardware to perform appropriate communications tasks and a software-implemented control which manages and controls these tasks.

In a preferred aspect of the present invention, these software-implemented controls are constructed as Java servlets, Java Beans and Java Enterprise Beans, as documented in Sun's 20 JavaSoft Java Servlet documentation and in the Java V1.1 documentation and inter-servlet communications is accomplished by way of Java's RMI services, also documented therein.

In an embodiment of the present invention, a wrapper has been added the conventional Java servlets to provide rapid synchronous and asynchronous communications. Specifically, the wrapper extends the functionality of the servlets from their conventional http-based "post" and 25 "get" API to a fully functional asynchronous messaging API by which messages can be sent to any servlet and received from any servlet via a sustained connection, or by a connection which is asynchronous. A servlet extended with this wrapper can communicate synchronously with any other servlet (extended or non-extended) and can also communicate asynchronously with any other extended servlet.

30 Essentially the wrapper comprises methods which the servlet must implement. The first method is "perform()" which is the synchronous event handler. It is called with an event, returns a value when complete and is blocked while an event is being processed. The second method is "performAsynch()" which is the asynchronous event handler. This method returns a "FutureReply" placeholder object as soon as possible. When event processing is complete, the method then sends 35 an asynchronous reply event to the caller servlet. The FutureReply placeholder includes a unique identifier which allows the receiving servlet to match a subsequently received reply event to the original event. With this method, the caller servlet is free to perform other processing while the

event is being processed.

To accommodate these two types of event handling, two different types of events are defined. Specifically, "ServletEvent" and "ServletAsynchEvent" are employed, the former being used for synchronous events and the latter for asynchronous events. In this system, events 5 comprise an identifier of type String, an argument, which can be any Object, and a Session. Because more than one servlet can send an event to an extended servlet, a Session, which is an object that includes a unique identification, is provided to assist the extended servlet in processing synchronous events by allowing the servlet to identify the ordering of events.

While Java servlets, Java Beans, Java Enterprise Beans and the Java RMI interface is 10 presently preferred for implementing the software components of network 14, it will be apparent to those of skill in the art that the present invention is not limited to such an implementation and CORBA (Common Object Request Broker) or other suitable implementations can be employed, in part or in whole, if desired.

As will be apparent to those of skill in the art, several advantages are realized with the use 15 of software-implemented controls. Specifically, regions 18 can have components added or removed while the network is in operation, without requiring network 14 to be shut down with the result that network 14 is scalable and network 14, regions 18 and region servers 24 remain operational while such component changes are being effected. Thus, for example, additional bridges 36 or different transducers 46 can be added to or removed from a region 18 as desired. 20 Further, new services and/or capabilities can also be added to regions 18 and merely requires that appropriate servlets be registered in the regions 18. This also allows for physical components to be serviced without affecting network 14 or regions 18.

Services and capabilities can also be loaded over network 18. For example, when a region 18 is started up, the services, adapters, gateways and transducers can be loaded onto region 18 over 25 the network from other regions 18 or from a data base maintained for that purpose on network 18. The components and services can also be loaded on demand from a specific region 18 or region server 24 within a region 18 when required. These services, etc. can be executed remotely for a region 18 or actually loaded into the region 18 and executed locally, as discussed below.

To implement this "hot-plugability", a layer of indirection is employed between 30 components of region 18 and requests for services of these components. In a presently preferred embodiment of the invention, region manager 22 maintains a record, or availability list, indicating the available components within a region 18 and each request for services of a component is made by accessing this list to determine the available components. To add new components and/or services to a region 18, an appropriate addition is made to this availability list when the 35 component/service is available. To remove a component for preventative maintenance, etc., the component is removed from the availability list and the component can be removed or taken off line when it has completed its present task. As will be apparent to those of skill in the art, the

availability list described above is only one possible manner in which a determination of the components available within a region 18 and/or other regions 18 can be accomplished and the present invention is not limited to the use of such a list.

This also allows for hardware and/or license balancing to be performed. For example, a 5 region 18 may include one or more text to speech transducers 46 which rely upon special purpose hardware or software which is capable of performing (or which is only licensed to perform) a fixed number of simultaneous transformations. In such a case, the service list can identify services/components which are to be employed before others and can also refer to components/service in other regions which can be accessed via communications backbone 28.

10 In the text to speech example, once the fixed number of simultaneous text to speech transformations is being performed, additional requests for text to speech transformations can be referred, via references in the service list, to another region 18 which has similar special purpose hardware, or which has additional licenses. In such a case, the service list can instead indicate an alternative transducer 46 which is less efficient than the licensed system, and which can be 15 employed only once all of the special purpose hardware transducers 46 are occupied. In this manner, requests for text to speech are met and the license, if any, is not exceeded and/or utilization of hardware is improved. As will be apparent, if a transducer 46 is not fully occupied, region manager 22 can permit other regions 18 to employ the surplus capacity, by reporting available capacity to these other regions 18 via backbone 28, thus permitting efficient use of the hardware 20 and/or licensed capacity of network 14.

In a similar fashion, the level of utilization of each region server 24 can be monitored by the region manager 22 and the service list can be appropriately updated by the region manager 22 to indicate that components at under utilized region servers 24 be employed before similar components at regions servers 24 with higher utilization levels.

25 Thus, efficient use can be made of existing network resources and resources can be added or removed, as desired. While it is presently preferred that region manager 22 maintain the service list for all components available in a region 18, it is also contemplated that in some circumstances service lists may be maintained at each region server 24 for some or all services provided therein. For example, it is contemplated that one or more region servers 24 maintain a list of transducers 46 30 available at the region server 24. It is also contemplated that, if a region server 24 does not find a required component available in its list, a request can be sent to other region servers 24, either directly or via region manager 22, via communications backbone 28 for access to the required component or a service list indicating services available at other regions 18 can be maintained in each region manager 22 and consulted, as needed, to determine where a service is available.

35 Region manager 22 can then either have the service remotely executed by another region 18 or can download the service, via network 14, onto a region server 24 in region 18 for execution thereon.

Another advantage of network 14 is its ability to provide tunneling for IP addresses (or

similar addressing schemes). Specifically, many network security models include the recognition of a user's IP address, as contained in the IP header on each IP packet, as part of the security model. A message received from an unrecognized IP address is generally refused by the network. While this model can provide reasonable results in many cases, it fails with mobile or nomadic users. For 5 example, the IP packets sent by a salesman trying to access his employers' network from a remote location will have a different IP address, once the packet is routed, than they would when sent from the salesman's home location, and the messages will thus be refused by the employers' network. With a network in accordance with the present invention, such as network 14, IP packets are "tunneled" between the home region and the remote region. A packet sent from the remote region 10 will be sent as an encapsulated packet to the home region, to preserve its IP address, and the home region will de-encapsulate the received packet and forward it to the desired service with the original IP header/address intact. Similarly, packets received at the home region from the service will be encapsulated and sent to the remote region where they will be de-encapsulated and transmitted to the user. This tunneling is performed transparently to the user whenever a user connects to a 15 remote region and is presently believed to provide significant advantages for users of networks employing IP address-based security models.

While only specific combinations of the various features and components of the present invention have been discussed herein, it will be apparent to those of skill in the art that desired subsets of the disclosed features and components and/or alternative combinations of these features and 20 components can be utilized, as desired.

The present invention provides a novel distributed network which allows users to access telecommunications and other services from any access point in the network. These services are provided transparently to the user. For example, the user need take no special steps to access an HTML document from a PCS telephone. These services are also provided transparently to the 25 service provider, for example the author of the HTML document does not need to alter the document to allow a user to access it from a PCS telephone. The network can be customized for each type of client using parameters known for that client as defined in a client registry and can be customized for each user's preferences, as defined in the user's profile. Communications through the network are independent of the transport protocol employed, as all protocol, data, API, etc. 30 conversions are automatically performed by the network. Also, the network and its services are transparent as to where the user connects to the network.

The present invention also provides a data stream conversion system and method which allows communications clients to connect to a network and access any service therefrom, such that the data streams from the service to the communications client are converting to a desired format 35 for the client without requiring specific input from the user of the client. The data conversion system and method receives information relating to the type of communications client, and any user defined preferences for data sent thereto, and information relating to the service being accessed

through the network and/or any service defined preferences for that communications client. The data conversion system and method then employs one or more transducers to convert the data stream accordingly, both to and from the communications client. The data conversion system and method also employs one or more transducers to convert a data stream received from the

5 communications client from the received format to a format required for the service.

The present invention also provides a novel method of servicing data access requests from users accessing a network with multiple connection points, the services being provided independent of the actual connection point and/or the communication client employed by the user to connect to the network. Further, new services can be added to the network as desired and distributed storage

10 of user information, user data, and other data is provided and access to such information from any network connection point is provided.

We claim:

1. A region for use in a distributed telecommunications network, comprising:
 - at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host
 - 5 operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;
 - at least one bridge connected to said at least one region server and operable to establish connections with communications clients;
 - at least one adapter connected to said at least one region server, said adapter operable to
 - 10 connect to an external service and to permit communications between said external service and said at least one region server; and
 - a region manager connected to each of said at least one region servers and operable to determine the type of a communications client connected to said region and to select a region server and a bridge connected thereto to maintain a connection with said communications client, and
 - 15 wherein data received from either of said external service and said communications client which is in a first data format incompatible with the other of said external service and said communications client is converted to a second data format appropriate to aid other of said external service and said communications client by said transducer.
- 20 2. A region according to claim 1 further including a set of at least two transducers, a first transducer in said set operable to convert an input data stream in a first format to an output data stream in a second format and a second transducer in said set operable to convert an input data stream in said second format into an output stream in a third format; and
 - a transducer matrix switch responsive to said type of communications client determined by
 - 25 said region manager and operable to select transducers from said set of transducers and to supply data output from a first transducer in said set as an input to a second transducer in said set such that data received in a first format from either of said external service and said communications client is converted to a data stream in said third data format required by the other of said external service and said communication network.
- 30 3. A region according to claim 2 wherein said set of transducers includes at least two transducers operable to convert an input data stream in a first format to an output stream in a second format, each of said at least two transducers operable to perform said conversion for data streams from a respective one of at a first connection between a first communications client and an external service and a second connection between a second communications client and an external service.

4. A region according to claim 1 further comprising at least two region servers and wherein each of said at least two region servers includes at least two bridges and at least two adapters.

5. A region according to claim 1 wherein said region manager includes a database engine defining types of communications clients which can connect to said at least one bridge.

6. A region according to claim 1 wherein the identity of the user of said communications device is verified by said region after said determination of said type of communications client is completed and before said region manager selects a region server and a bridge connected thereto to maintain a connection with said communications client.

7. A region according to claim 6 wherein said region manager includes a database engine which is employed to verify the identity of a user of a communications client connecting to said at least one bridge.

15 8. A region according to claim 6 wherein said at least one region server verifies the identity of a user of a communications client connecting to said at least one bridge with verification information provided from said communications backbone.

20 9. A region according to claim 4 wherein said region manager monitors each of said region servers to determine the utilization thereof and is operable to transfer connections between bridges connected to different ones of said at least two region servers to balance said utilization.

10. A region according to claim 1 wherein data transmitted from said region to said 25 communications client is formatted according to said determined type of said communications client.

11. A region according to claim 6 wherein data transmitted from said region to said 30 communications client is formatted according to said determined type of said communications client.

12. A region according to claim 10 wherein a set of preferences is predefined by a user of said communications clients to vary said formatting for each type of communications client according to preferences of said user.

35 13. A distributed service network comprising at least two regions as claimed in claim 1, each of said at least two regions being connected by said communications backbone.

14. A distributed service network comprising at least two regions connected by a communications backbone, each said region comprising:

at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host 5 operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

at least one bridge connected to said at least one region server and operable to establish connections with communications clients;

at least one adapter connected to said at least one region server, said adapter operable to 10 connect to an external service and to permit communications between said external service and said at least one region server; and

15 a region manager connected to each of said at least one region servers and operable to determine the type of a communications client connected to said region and to select a region server and a bridge connected thereto to maintain a connection with said communications client, and wherein data received from either of said external service and said communications client which is in a first data format incompatible with the other of said external service and said communications client is converted to a second data format appropriate to aid other of said external service and said communications client by said transducer.

20 15. A distributed services network according to claim 14 where at least one of said at least two regions comprises at least two region servers and wherein each of said at least two region servers includes at least two bridges and at least two adapters.

16. A distributed services network according to claim 14 further comprising at least one 25 database engine connected to said region servers and containing definitions of types of communications clients which can connect to said network.

17. A distributed services network according to claim 16 further including at least one database engine connected to said region servers and containing user defined preferences to be employed 30 with connections between a user and said network.

18. A distributed services network according to claim 17 wherein said database containing said user defined preferences is maintained for each user in a region defined as a home region for said user and is accessed via said communications backbone when said user established a connection 35 with a remote region which is a region other than said home region.

19. A distributed services network according to claim 18 wherein said database engine further maintains information for said network to verify the identity of a user.

20. A distributed services network according to claim 18 wherein said access of said 5 preferences comprises replicating at least a portion of said user defined preferences in a database engine at said remote region.

21. A distributed services network according to claim 20 wherein said replicated portion is stored in a persistent cache at said remote region.

10 22. A distributed services network according to claim 21 wherein said preferences further includes information permitting access by the user to external services and information relating to activities of said user with said external services.

15 23. A distributed services network according to claim 22 wherein additional portions of said preferences are replicated to said persistent cache corresponding to service requests made by said user.

24. A distributed services network according to claim 23 wherein updates are transferred to said 20 home region of said user to modify said user defined preferences and said information permitting access and said information relating to activities of said user to correspond with those in said replicated portion.

25. A region for use in a reconfigurable distributed telecommunications network, comprising:
at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

30 at least one bridge or other component connected to said at least one region server and operable to establish connections with communications clients;
at least one adapter connected to said at least one region server, said adapter operable to connect to a service and to permit communications between said service and said at least one region server; and

35 a region manager connected to each of said at least one region servers and maintaining a record indicative of the services and components available on each of said at least one region servers, said region manager operable to determine the type of a communications client connected

to said region and to select from said record a region server and a bridge or other component connected thereto to service a connection with said communications client.

26. A region according to claim 25 wherein additional services and components added to any of 5 said at least one region servers form part of said network region upon updating said record to include said added services and components.

27. A region according to claim 25 wherein services and components of any of said at least one 10 region servers are removed from said network by updating said record to remove reference to said services and components, said services and components thus being operable to complete a current task before being removed from said network region.

28. A region according to claim 25 wherein said record maintained by said region manager 15 further comprises an indication of the order in which said services and components are to be utilized within said region.

29. A region according to claim 28 wherein said record maintained by said region manager further comprises an indication of external services and components available, via said 20 communications host, at another network region, said externally available services and components only being selected when said services and components of said network region are in use.

30. A region according to claim 28 wherein said region manager alters said order according to the degree of utilization of each of said at least one region servers, services and components at 25 region servers with relatively low utilization being placed in said order before services and components at region servers with relatively high utilization.

31. A region according to claim 25 wherein said region manager includes a database engine 30 which is employed to verify the identity of a user of a communications client connecting to said at least one bridge.

32. A region according to claim 25 wherein said components include transducers within a data stream conversion system, said transducers operable to convert an input data stream from a first data format to an output data stream in a different data format.

35 33. A reconfigurable distributed service network comprising at least two regions as claimed in claim 25, each of said at least two regions being connected by said communications backbone.

34. A reconfigurable distributed service network comprising at least two regions connected by a communications backbone, each said region comprising:

at least one region server including at least one transducer operable to convert an input data stream in a first format to an output data stream in a second data format and a communications host operable to communicate with other region servers in said distributed telecommunications network via a communications backbone;

at least one bridge connected to said at least one region server and operable to establish connections with communications clients;

at least one adapter connected to said at least one region server, said adapter operable to connect to an external service and to permit communications between said external service and said at least one region server; and

a region manager connected to each of said at least one region servers and maintaining a record indicative of the services and components available on each of said at least one region servers, said region manager operable to determine the type of a communications client connected to said region and to select from said record a region server and a bridge or other component connected thereto to service a connection with said communications client.

35. A network according to claim 34 where at least one of said at least two regions comprises at least two region servers and wherein each of said at least two region servers includes at least two bridges and at least two adapters, said record maintained by said region manager further comprising an indication of the order in which said services and components are to be utilized within said at least one of said at least two regions.

36. A network according to claim 34 wherein said region manager in at least one said region alters said order according to the degree of utilization of each of said at least one region servers, services and components at region servers with relatively low utilization being placed in said order before services and components at region servers with relatively high utilization, further comprising at least one database engine connected to said region servers and containing definitions of types of communications clients which can connect to said network.

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37. A network according to claim 34 wherein said components include transducers within a data stream conversion system, said transducers operable to convert an input data stream from a first data format to an output data stream in a different data format.

35 38. A method of processing data access requests of users connected to a reconfigurable distributed service network comprising a plurality of interconnected network regions each comprising at least one region server, said users employing at least one of a plurality of types of

communications clients and said network connected to a plurality of services, comprising the steps of:

- (i) maintaining for network each region a record indicating the components available for use in said network region;
- 5 (ii) determining the type of communications client employed by the user and connecting said communications client to an available component, selected from said record, appropriate to said client;
- (iii) receiving a data access request from said user for a service selected by said user from said plurality of services; and
- 10 (iv) connecting said communications client to an available component, selected from said record, to connect said communications client to said selected service.

39. The method of claim 38 wherein said components include transducers in a data stream conversion system and step (iv) further comprises the step of employing available transducers, as 15 determined from said record, required to appropriately convert data streams between said communications client and said service.

40. The method of claim 38 further comprising the step of, from time to time, adding new components to at least one said network region and updating said record accordingly.

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41. The method of claim 38 further comprising the step of ordering said record to indicate the order in which like components are accessed.

42. The method of claim 41 wherein said order is dependent upon the degree of utilization of 25 each said region server in said network region.

43. A data stream conversion system comprising:

at least two transducers, each operable to receive an input stream of data in a first format and to create an output stream of said data in a format other than said first format; and

30 a transducer matrix switch operable to select at least one of said transducers and to provide said first input stream of data thereto and to receive said output stream of data therefrom, said selection being based upon an input signal to said transducer matrix switch indicating said first format and a desired different data format.

35 44. A data stream conversion system according to claim 43 wherein said transducer matrix switch is operable to select at least first and second transducers and to provide said input data stream to said first transducer and to provide said output stream of said first transducer as an input

stream to said second transducer, said first transducer converting said input data from said first format to an output stream in a second format and said second transducer converting said input stream from said second format to said desired format.

5 45. A data stream conversion system according to claim 43 wherein said transducer matrix switch maintains a record of transducers and their input and output formats and additional transducers can be added to said data conversion system and said list updated accordingly as required.

10 46. A data stream conversion system according to claim 43 wherein said matrix transducer switch includes a record indexed by each input and output format of each transducer and wherein entries in said record define the selection of at least one transducer to accomplish a conversion between said input format and said desired output format.

15 47. A data stream conversion system according to claim 43 wherein at least a first transducer is employed to convert a data stream received from a first communications device to a desired format for a second communications device and wherein at least a second transducer is employed to convert a data stream from said second communications client to a desired format for said first communications device.

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48. A data stream conversion system according to claim 47 wherein at least one of said first and second communication devices is a communications client employed by a user.

49. A data stream conversion system according to claim 48 wherein the other of said at least one of said first and second communications devices is a service being accessed by said user.

50. A data stream conversion system according to claim 47 wherein said first transducer performs an inverse of the conversion performed by said second transducer.

30 51. A data stream conversion system according to claim 43 wherein said matrix transducer switch employs at least two transducers in parallel, each of said at least two transducers converting said data stream in a first format to a different respective desired output format.

52. A data stream conversion system according to claim 43 wherein said first input stream is received from a communications service and said input signal includes a first signal received from said service indicating said first data format and further including a second signal received from a

bridge to which a communications client is connected, said second signal indicating said desired format.

53. A data stream conversion system according to claim 52 wherein said input signal further includes a third signal indicating one or more preferences of a user of said communications client, said third signal further defining said desired format.

54. A data stream conversion system according to claim 47 wherein said input signal includes a first signal from said first communications client and a second signal from said second 10 communications client, said first and second signals defining said input data format and desired format of each of said first and second communication clients.

55. A data stream conversion system according to claim 54 wherein at least one of said first and second communications clients is a service.

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56. A distributed communications network including a data stream conversion system as defined in claim 43 to convert data streams transmitted through said network between communications clients and services.

20 57. A method of converting a data stream transferred between a communication client connecting a user to a distributed service network and a service connected to said network, comprising the steps of:

(i) determining the type of said communications client and the required data characteristics of said client;

25 (ii) determining the required data characteristics of said service;

(iii) selecting at least one conversion means operable to convert a data stream between said required data characteristics of said client and said required data characteristics of said service;

(iv) applying said at least one conversion means to a data stream transferred through said network.

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58. A method according to claim 57 where in step (iii) at least two conversion means are selected, one of said at least two conversion means receiving data streams transferred through said network in a first format corresponding to a first one of said required data characteristics and converting it to a second format and the other of said at least two conversion means receiving said 35 converted data stream in said second format and converting it to a third format corresponding to the other of said required data characteristics and transferring said data in said third format through said network.

59. A method according to claim 57 wherein said selection in step (iii) is performed by consulting a lookup table indexed by said first and second required data characteristics.

60. A method according to claim 57 where in step (I) the determination of the characteristics of 5 said client further comprises the step of determining any user defined preferences for said characteristics.

61. A method of servicing data access requests for a user accessing a network via a communications client connected to any one of two or more network regions, comprising the steps 10 of:

(i) determining at said network region the type of communications client and transferring said connection to a bridge at said network region which is appropriate for said determined type of client;

(ii) verifying the identity of said user;

15 (iii) determining any predefined preferences of said identified user and the services which said identified user is able to access by accessing a user profile stored for said user by said network; and

20 (iv) allowing said user to access any of said determined services, said network region converting data streams to and from said client between a format appropriate to said determined type of client and a format employed by said accessed service.

62. A method according to claim 61 wherein step (ii) further comprises the step of determining if said network region is a home region defined for said user or a remote region.

25 63. A method according to claim 62 wherein, when said network region is determined to be a remote region for said user, in step (iv) said access to said determined services is provided from said home region, via a communication backbone linking said remote region and said home region, such that address and other identifying information from said home region to said accessed service corresponds to the address and other identifying information of said home region.

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64. A method according to claim 62 where in step (iii) at least a portion of said user profile is replicated to said remote region when said user has connected to said network at a remote region.

65. A method according to claim 64 wherein said portion of said user profile is maintained in a 35 persistent cache in said remote region.

66. A method according to claim 65 wherein said user profile further includes information providing access to said services.

67. A method according to claim 66 wherein said remote region communicates with said home region to update said user profile in said home region with changes to said user profile resulting from user activities at said remote region.

68. A method according to claim 66 wherein said remote region and said home regions maintain said portion of said user profile at said remote region and said user profile at said home region in correspondence by transmitting updates through said network reflecting changes in said information at either of said home and said remote region to the other of said home and said remote region.

69. A method according to claim 65 wherein, after said user disconnects from said network, said information is maintained in said persistent cache at said network region until the earlier of a predefined time period and the time at which the user reconnects to said network at a different network region.

70. A method according to claim 61 further comprising the step of monitoring said connection to determine changes to said connected client and, upon detection of a change in the type of said connected client, re-performing steps (iii) and (iv).

71. A method of processing data access requests of users connected to a distributed service network, said users employing at least one of a plurality of types of communications clients and said network connected to a plurality of services, comprising the steps of:

(i) determining the type of communications client employed by the user and retrieving parameters defining required characteristics of said communications client from a storage location in said network;

30 (ii) receiving a data access request from said user for a service selected by said user from said plurality of services;

(iii) determining the required characteristics of data to and from said selected service; and

(iv) automatically converting data transferred between said service and said communications client in accordance with said required characteristics of said communications client and said determined characteristics of said user-selected service.

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72. The method of claim 71 where in step (iv) said data is converted also in accordance with user-defined preferences stored in said network.

73. A method according to claim 71 further comprising the step of monitoring said connection to determine changes to said connected communications client and, upon detection of a change in the type of said connected communication client, re-performing steps (I) through (iv).
- 5 74. A method of processing data access requests from users connected to a distributed service network including multiple connection points, comprising the steps of:
- (i) establishing a connection to a user at a connection point to said network;
 - (ii) locating information defined for said user and stored at a defined location within said network;
 - 10 (iii) transferring a copy of at least a portion of said information from said defined location to said connection point through said network;
 - (iv) processing data access requests from said user in accordance with said copied information and transferring a copy of additional information required to fulfill said requests from said defined location to said connection point;
 - 15 (v) transmitting, over said network between said defined location and said connection point, updates representing changes effected at each of said stored information defined for said user and said copy of said information to each of the other of said stored information defined for said user and said copy of said information to maintain correspondence therebetween.
- 20 75. A method according to claim 74 wherein said portion comprises identification defined for said user.
76. A method according to claim 74 wherein said information defined for said user further comprises a personal agent defined for said user.
- 25
77. A method according to claim 74 wherein said copied information is maintained at said connection point until said user connects to said network at another connection point.

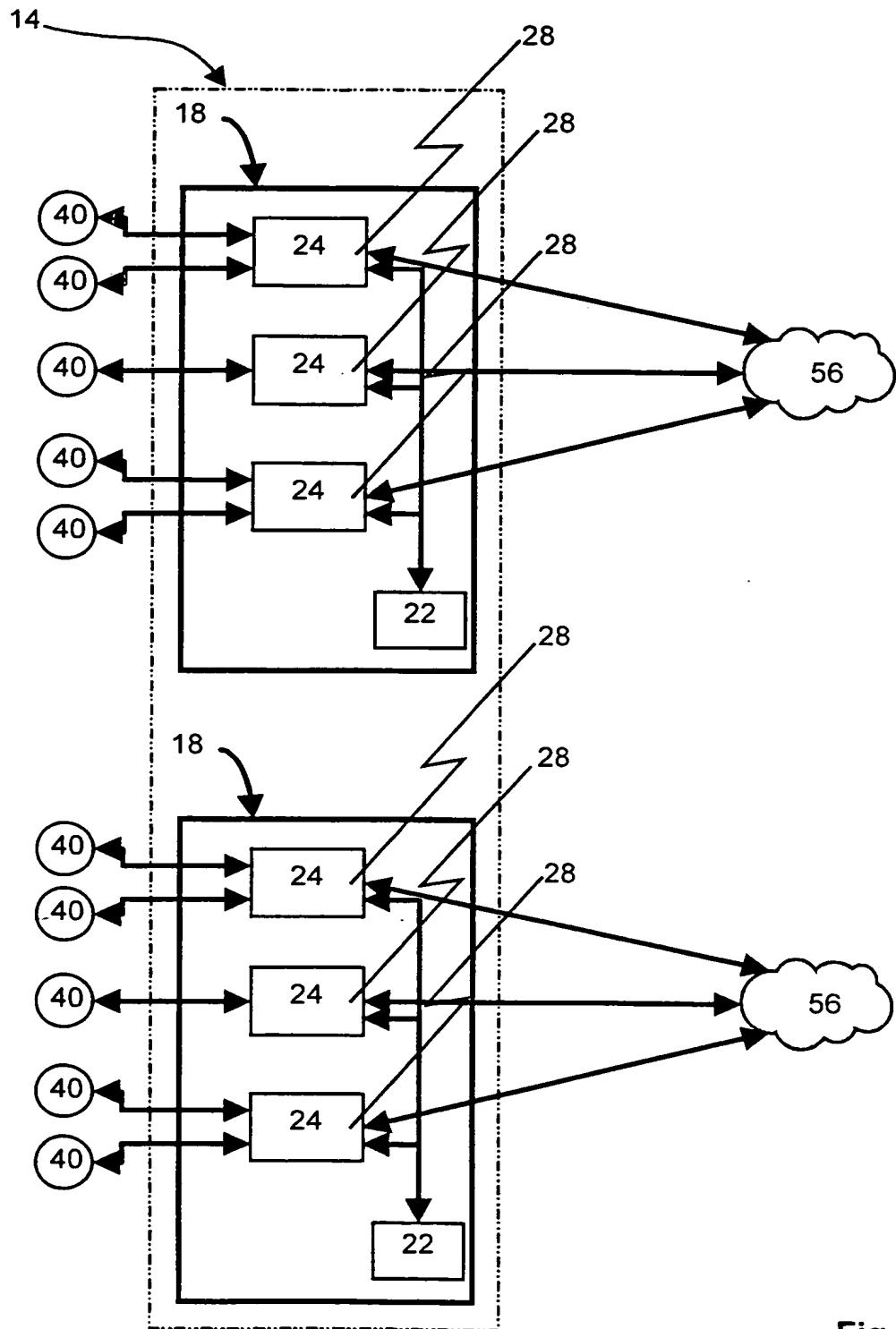
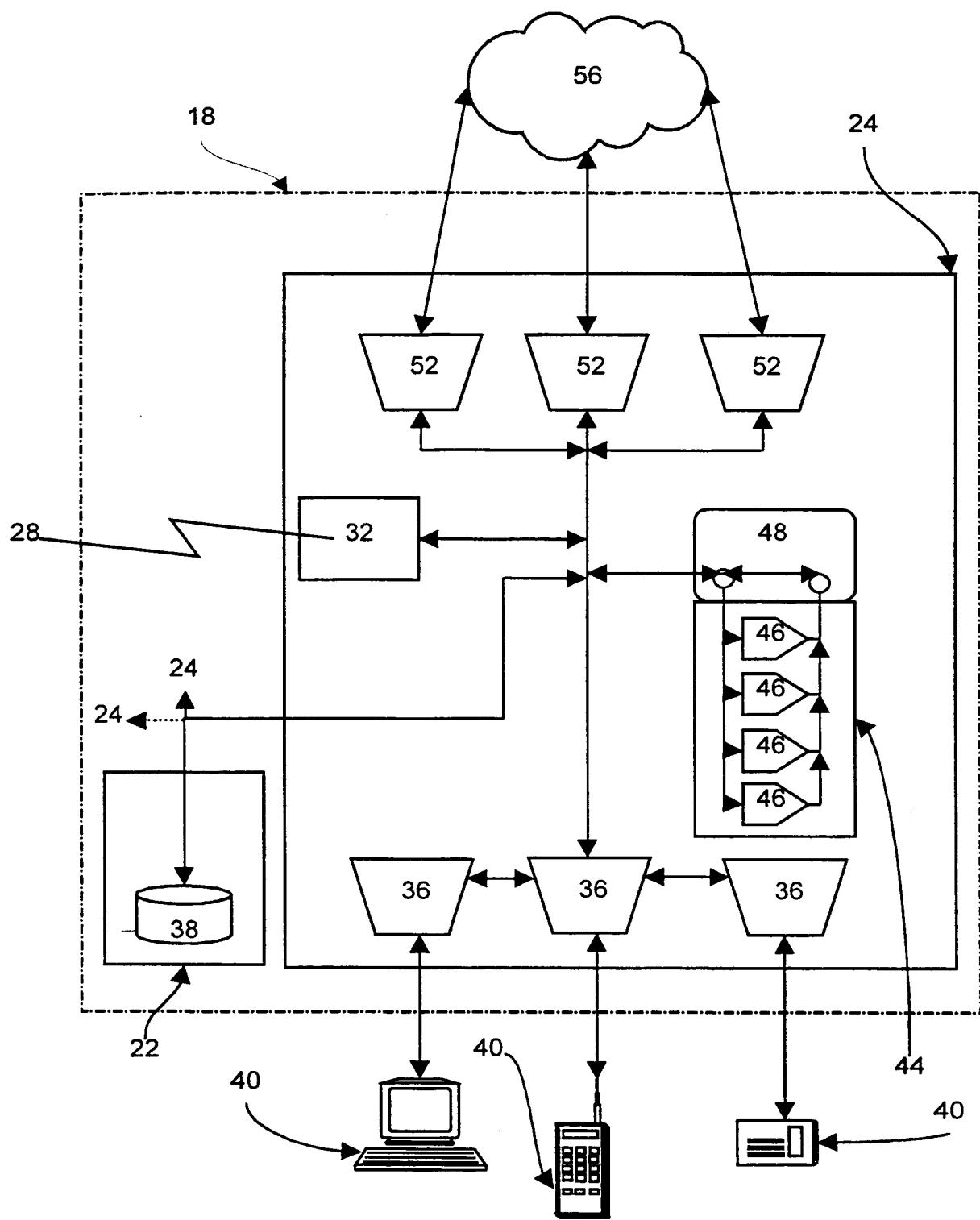
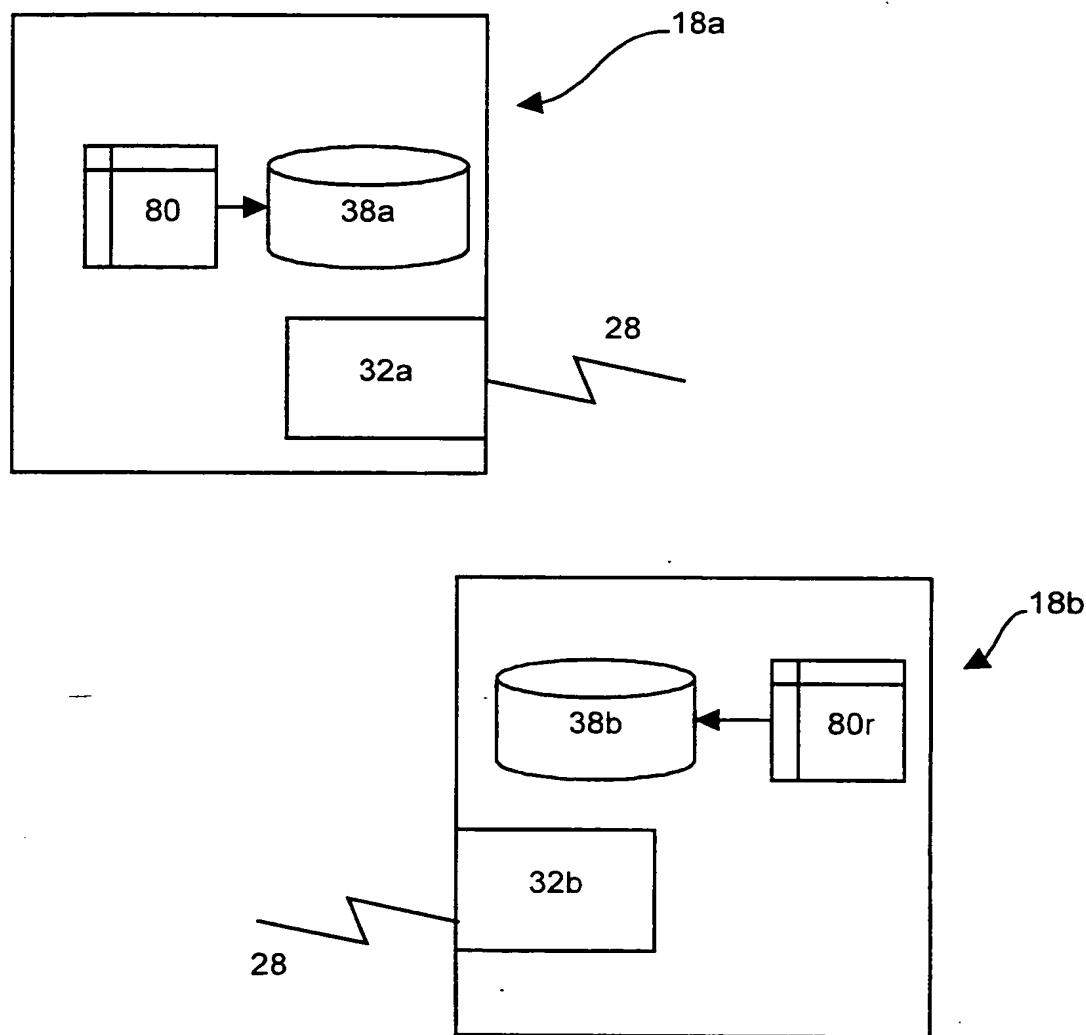


Fig.1

2/3Fig.2

**Fig.3**

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/CA98/01047		(72) Inventors: TRUDEAU, Joseph, Jean-Paul, Denis; 109 Primrose Avenue, Ottawa, Ontario K1R 6M2 (CA). CRADDOCK, Arthur, Julian, Patterson; 6486 Waddington Drive, Greely, Ontario K4P 1E7 (CA). KHUWAJA, Ramzan, A.; 18 Deerfield Drive, #1603, Nepean, Ontario K2G 4L1 (CA). ARMSTRONG, Steve, Michael; 24 Hillview Road, Nepean, Ontario K2H 5G5 (CA). PARSONS, Eric, Walter; 3 Lakewood Drive, Richmond, Ontario K0A 2Z0 (CA). MACFARLANE, Ian, Alexander; 15 Victor Street, Stittsville, Ontario K2S 1H9 (CA).																									
(22) International Filing Date: 9 November 1998 (09.11.98)		(74) Agents: STRATTON, Robert, P. et al.; Gowling, Strathy & Henderson, Suite 4900, Commerce Court West, Toronto, Ontario M5L 1J3 (CA).																									
(30) Priority Data:		<table> <tr> <td>2,220,578</td> <td>10 November 1997 (10.11.97)</td> <td>CA</td> </tr> <tr> <td>2,220,579</td> <td>10 November 1997 (10.11.97)</td> <td>CA</td> </tr> <tr> <td>2,220,580</td> <td>10 November 1997 (10.11.97)</td> <td>CA</td> </tr> <tr> <td>2,220,641</td> <td>10 November 1997 (10.11.97)</td> <td>CA</td> </tr> <tr> <td>09/041,131</td> <td>12 March 1998 (12.03.98)</td> <td>US</td> </tr> <tr> <td>09/041,130</td> <td>12 March 1998 (12.03.98)</td> <td>US</td> </tr> <tr> <td>09/041,129</td> <td>12 March 1998 (12.03.98)</td> <td>US</td> </tr> <tr> <td>09/041,128</td> <td>12 March 1998 (12.03.98)</td> <td>US</td> </tr> </table>		2,220,578	10 November 1997 (10.11.97)	CA	2,220,579	10 November 1997 (10.11.97)	CA	2,220,580	10 November 1997 (10.11.97)	CA	2,220,641	10 November 1997 (10.11.97)	CA	09/041,131	12 March 1998 (12.03.98)	US	09/041,130	12 March 1998 (12.03.98)	US	09/041,129	12 March 1998 (12.03.98)	US	09/041,128	12 March 1998 (12.03.98)	US
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(71) Applicant: NORTHERN TELECOM LIMITED [CA/CA]; Station A, P.O. Box 6123, Montreal, Quebec M3C 3J5 (CA).		(81) Designated States: CA, CN, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).																									
<p>Published <i>With international search report.</i></p> <p>(88) Date of publication of the international search report: 28 October 1999 (28.10.99)</p>																											
<p>(54) Title: DISTRIBUTED SERVICE NETWORK</p> <p>(57) Abstract</p> <p>A distributed service network provides telecommunications and other services to users via components and services at interconnected network regions. Each region maintains a record of the services and components available in the region and utilization of these services and/or components is obtained by reference to the record. New services and components can be added to the region by updating the record, and services and components can be removed from the region, for preventative maintenance, etc., by appropriately updating the record. Entries in the record can be ordered to determine the order in which like components and/or services are utilized and this order can be set according to the degree of utilization of region servers on which said services and/or components are installed. It is also possible to include services and/or components at other regions, which are accessible via a communications backbone, in the record of services and components in a region.</p>																											

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 98/01047

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06F17/22

According to international Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06F H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>WO 93 23817 A (RELEASE MANAGEMENT SYSTEMS RMS ;TCS ENTERPRISES INC (US)) 25 November 1993</p> <p>see figures 1-5,7-9</p> <p>see page 6, line 14 - page 10, line 28</p> <p>-----</p>	1-42, 57-73

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

19 May 1999

Date of mailing of the international search report

26. 08. 99

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patenttaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl
Fax: (+31-70) 340-3016

Authorized officer

Eraso Helguera, J

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA 98/01047

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-42, 57-73

Remark on Protest:

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-42,57-73

A region, a network and a method for distributed telecommunications services including region servers with transducers operable to intercommunicate a plurality of clients using different data formats under the control of a region manager.

2. Claims: 43-56

A data stream conversion system comprising a transducer matrix switch.

3. Claims: 74-77

A method for processing data access requests from users connected to a distributed service network comprising the transfer and update of user information between the location where it is stored and the user connection point.

INTERNATIONAL SEARCH REPORT

Info. on patent family members

International Application No

PCT/... 98/01047

Patent document cited in search report	Publication date	Patent family member(s)		Publication date	
WO 9323817 A	25-11-1993	AU 4237293 A	13-12-1993	US 5627972 A	06-05-1997